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FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **CAF-29302/03**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **10/031219**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB00/02712	**14 July 2000**	**15 July 1999**

TITLE OF INVENTION: **DOWNHOLE BYPASS VALVE**

APPLICANT(S) FOR DO/EO/US: **CHURCHILL, Andrew Philip**

25006
PATENT _TRADEMARK OFFICE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Abstract on Seperate Sheet

PCTUS1/REV03

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/031219	PCT/GB00/02712	CAF-29302/03

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**	
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**	
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**	
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
	ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**
	Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	27 - 20 =	7	x $18.00	**$126.00**
Independent claims	4 - 3 =	1	x $84.00	**$84.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**

TOTAL OF ABOVE CALCULATIONS =	**$1,100.00**
☒ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.	**$550.00**
SUBTOTAL =	**$550.00**
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	**$0.00**
TOTAL NATIONAL FEE =	**$550.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐	**$0.00**
TOTAL FEES ENCLOSED =	**$550.00**
Amount to be: refunded	$
charged	$

a. ☒ A check in the amount of **$550.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **07-1180** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Judith M. Riley, Reg. No. 31,561
Gifford, Krass, Groh, Sprinkle, Anderson & Citkowski, P.C.
280 N. Old Woodward Ave., Ste. 400
Birmingham, MI 48009
US

SIGNATURE

Judith M. Riley
NAME

31,561
REGISTRATION NUMBER

15 January 2002
DATE

Attorney Docket No. CAF-29302/03

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Andrew Philip Churchill

Serial No.:

Filed: 15 January 2002

For: DOWNHOLE BYPASS VALVE

PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination of the above-referenced patent application, please amend the above-referenced application in the following manner:

IN THE SPECIFICATION:

Before line 1 of page 1 please insert:

Field of the Invention

Before line 9 of page 1 please insert:

Background of the Invention

Before line 22 of page 1 please insert:

Summary of the Invention

Before line 2 of page 10 please insert:

Brief Description of the Drawings

Before line 26 of page 10 please insert:

Detailed Description of the Preferred Embodiments

IN THE CLAIMS:

Please cancel claims 1-35.

Please add new claims 36-62 as follows:

36. (New) A downhole bypass tool comprising:

a body adapted to be mounted on a tubular string and defining an axial through bore to allow fluid to flow through the body and including a wall defining a fluid port for permitting passage of fluid between the body bore and the exterior of the body;

an operating sleeve mounted to the body and normally positioned to close the fluid port;

an activating device adapted to be dropped through the string to land on the operating sleeve; and

a flow restriction operatively associated with the operating sleeve and located upstream of the port, the flow restriction being configured to create a fluid flow-related force on the operating sleeve for moving the sleeve to open the body port following landing of the activating device.

37. (New) The tool of claim 36, wherein the activating device provides the flow restriction.

38. (New) The tool of claim 36, further comprising a biasing member for urging the operating sleeve to close the fluid port.

39. (New) The tool of claim 36, further comprising locking means for retaining the operating sleeve in position to close the fluid port, the locking means releasing the operating sleeve on landing of the activating device on the sleeve.

40. (New) The tool of claim 39, wherein the locking means includes a coupling for releasably coupling the operating sleeve to the body.

41. (New) The tool of claim 36, further comprising at least two axially spaced flow restrictions associated with the operating sleeve and located upstream of the port.

42. (New) The tool of claim 36, wherein the activating device is an activating sleeve having an axial through bore.

43. (New) The tool of claim 36, wherein the activating device is a deformable plug.

44. (New) The tool of claim 43, wherein the deformable plug is a ball.

45. (New) The tool of claim 36, further comprising indexing means for controlling movement of the operating sleeve and configured to permit the operating sleeve to be retained in one of the port open and port closing positions while fluid flow through the tool is maintained at a normal operational level.

46. (New) The tool of claim 45, wherein the indexing means includes a cam arrangement.

47. (New) A method of providing fluid bypass in a downhole string, the method comprising the steps:

providing a bypass tool having a body defining an axial through bore and including a wall defining a fluid port, and an operating sleeve mounted to the body and normally positioned to close the port;

running the tool into a bore on a string;

dropping an activating device through the string to land on the operating sleeve; and

passing fluid through the string, body and operating sleeve, and also a flow restriction operatively associated with the operating sleeve and located upstream of the port, at selected flow rates to create selected fluid flow-related forces on the operating sleeve to move the sleeve to open the port.

48. (New) The method of claim 47, further comprising maintaining fluid flow through the string, body and operating sleeve at a normal operational level at least as the activating device passes through the string and lands on the operating sleeve.

49. (New) The method of claim 48, further comprising maintaining fluid flow through the string, body and operating sleeve at a normal operational level

following landing of the activating device on the operating sleeve, and at least initially retaining the sleeve in position to close the fluid port.

50. (New) A downhole tool having first and second configurations and adapted to be run into a bore in the first configuration, the tool comprising:

a body adapted to be mounted on a tubular string and having an axial through bore for permitting passage of fluid therethrough while the tool remains in the first configuration;

an activating sleeve configured to travel through the string to land on the body and activate the tool; and

flow responsive means for cycling the activated tool between the first and second configurations in response to variations in fluid flowrate through the tool.

51. (New) The tool of claim 50, further comprising indexing means for controlling cycling of the tool between the first and second configurations and permitting the tool to be in either one of the first and second configurations while the fluid flowrate is maintained at a normal, operational level.

52. (New) The tool of claim 50, wherein the activating sleeve is adapted to release a coupling on landing on the body to activate the tool into the second configuration.

53. (New) The tool of claim 50, further including means for biasing the tool towards the first configuration.

54. (New) The tool of claim 50, wherein the flow responsive means includes a differential piston.

55. (New) The tool of claim 50, wherein the flow responsive means includes a flow restriction.

56. (New) The tool of claim 55, wherein the flow restriction is defined by the activating sleeve.

57. (New) The tool of claim 55, wherein the flow responsive means includes at least two axially spaced flow restrictions.

58. (New) The tool of claim 50, wherein the tool is a bypass tool, the body defining a bypass port and wherein the bypass port is closed in the first configuration and open in the second configuration.

59. (New) A method of operating a downhole tool, the method comprising:

running a tool into a bore on a string with the tool in a first configuration;

passing fluid through the string and an axial through bore defined by the tool with the tool remaining in the first configuration;

passing an activating sleeve from surface through the string to land on and activate the tool; and

cycling the activated tool between first and second configurations in response to variations in fluid flowrate through the tool.

60. (New) The method of claim 59, further comprising maintaining fluid flow through the string and body at a normal operational level at least as the activating sleeve passes through the string and lands on the tool.

61. (New) The method of claim 60, further comprising maintaining fluid flow through the string and body at normal operational level following landing of the activating sleeve on the tool, and at least initially retaining the tool in the first configuration following landing of the activating sleeve on the tool.

62. (New) The method of claim 59, further comprising maintaining the tool in the first configuration while the fluid flowrate is maintained at a normal, operational level, and subsequently maintaining the tool in the second configuration while the fluid flowrate is maintained at a normal, operational level.

REMARKS

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

If the Examiner has any questions relating to the application, Applicant's attorney may be reached at (248) 647-6000.

Respectfully submitted,

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Date: 1/15/02

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GS–W:\Word Processing\jmr\CAF29302-pre.doc

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The following section headings have been added to the specification:

Before line 1 of page 1:

Field of the Invention

Before line 9 of page 1:

Background of the Invention

Before line 22 of page 1:

Summary of the Invention

Before line 2 of page 10:

Brief Description of the Drawings

Before line 26 of page 10:

Detailed Description of the Preferred Embodiments

IN THE CLAIMS:

Claims 1-35 have been cancelled.

New claims 36-62 have been added.

Abstract

A fluid flow actuated downhole tool is configurable in at least a first tool configuration and a second tool configuration. The tool comprises a tubular housing and an activating sleeve, the housing being adapted to catch the sleeve when the sleeve is dropped from surface and the engagement of the sleeve with the housing permitting actuation of the tool between the first and second tool configurations. A flow restriction is provided for permitting fluid flow actuation of the tool when the activating sleeve has been caught in the body.

DOWNHOLE BYPASS VALVE

The present invention relates to a downhole tool which is actuatable between at least two tool configurations. In particular, but not exclusively, the present invention relates to a downhole tool comprising a bypass tool for location in a borehole of a well, wherein the bypass tool is actuatable between a closed configuration and an open configuration in response to the flow of fluid through the borehole.

Bypass tools are typically disposed within a borehole of, for example, an oil well, for selectively allowing fluid communication between a bore defined by a tubular string disposed in the borehole, and an annulus defined between an outer wall of the tubing string and an inner wall of the borehole. Typical known assemblies are often complex, comprising many interconnected components, and often require, for example, multiple fluid pressure cycles of fluid in the borehole to actuate the bypass tool between two or more distinct tool configurations.

It is amongst the objects of the present invention to obviate or mitigate at least one of the foregoing disadvantages.

According to the present invention there is provided a fluid flow actuated downhole tool being configurable in

at least a first tool configuration and a second tool configuration, the tool comprising:

a tubular housing;

an activating sleeve, the housing being adapted to catch the sleeve when dropped from surface and then permitting actuation of the tool between the first and second tool configurations; and

flow restriction means for permitting fluid flow actuation of the tool when the activating sleeve has been caught in the body.

The invention also relates to a method of operating a fluid flow actuated tool, the method comprising:

running the tool into a borehole in a tubular string;

circulating fluid through the string and the tool;

passing an activating sleeve into the string;

catching the sleeve in the tool; and

circulating fluid through the string, the sleeve and a flow restriction in the tool to actuate the tool.

Thus, prior to the sleeve being caught in the tool, the tool is "dormant", and may only be actuated after the sleeve is received in the tool.

As noted above the sleeve is simply dropped into the string and is allowed to fall through the string, or may in addition also be carried into the string by circulating fluid.

Unlike a ball or other flow occluding tool activating

member, which will substantially occlude the string bore, the use of a tool activating sleeve allows fluid to continue to flow through the string and tool, and may permit access to the section of the bore below the tool. Also, the use of a sleeve allows fluid to be circulated while the sleeve is moving down through the string; unlike a ball or other flow-occluding device, the sleeve will not induce a large hydraulic shock on engaging the tool.

The sleeve may define a flow restriction, such as a nozzle, which flow restriction permits or facilitates fluid actuation of the tool. Alternatively, the restriction may be defined by another part of the tool, which part is fixed before the sleeve is caught in the tool. Two or more axially spaced flow restrictions may be provided, allowing creation of a greater fluid pressure force without a significant restriction in bore diameter.

The tool may be a bypass tool, preferably the tool being initially closed, and after the sleeve is caught in the tool the tool may be re-configured to permit flow between the tool bore and the surrounding annulus.

Preferably, following activation of the tool by the sleeve, the tool may be repeatedly actuated between the first and second configurations.

A further aspect of the invention relates to a method of operating a fluid flow actuated tool, the method comprising:

(a) running the tool into a borehole in or as a part of a tubular string;

(b) circulating fluid through the string and tool;

(c) passing an activating device into the tool;

(d) catching the device in the tool;

(e) circulating fluid through the string and the tool including the device, to actuate the tool; and

(f) repeating step (e) at least once.

Preferably, the activating device is a sleeve, which may define a restriction or nozzle, incorporate a rupture disc, or contain an extrudable or soluble material.

The activation for the tool may be achieved by releasing a coupling to permit relative movement of parts of the tool, which coupling may be, for example, a shear coupling or a sprung coupling.

Another aspect of the invention relates to a method of actuating a downhole tool, the method comprising:

running a tool into a borehole in a tubular string;

circulating fluid through the string and tool;

locating an activating device in the string; and

circulating fluid through the string and tool as the device travels down through the string, as the device engages the tool, and following engagement of the device and the tool.

This method is particularly useful in drilling or circulating operations, as there is no requirement to stop

fluid circulation as the device moves through the string and then engages the tool, such that drilling or circulation may continue with the device in the string with a fluid flowrate sufficient to entrain drill cutting and carry them to surface, or to allow continuation of some other fluid circulation-related activity. This contrasts with conventional methods, in which it is necessary to stop or at least substantially reduce circulation to prevent the occurrence of a hydraulic shock on the activating device, typically in the form of a steel ball, engaging the tool. Such a hydraulic shock would result in damage to the ball and tool, and possibly also to the string itself.

The activating device may be a sleeve, such that the device restricts fluid flow to a limited extent but does not occlude the string bore.

A still further aspect of the present invention provides a downhole tool for disposition in a borehole of a well, the tool being configurable in at least a first and a second tool configuration, the tool comprising:

a tubular housing for running into a borehole on a tubing string;

a tubular sleeve assembly for disposition within the tubular housing and axially movable therein and including fluid responsive means for actuating the tool between said first and second tool configurations; and

means for maintaining said sleeve assembly in a

selected one of said first and second tool configurations.

Thus the present invention allows a downhole tool to be disposed in a borehole, which tool may be actuated between two or more tool configurations by supplying fluid to the tool in the borehole and by varying the flow rate of the fluid through the tool.

Preferably, the downhole tool is a bypass tool. The bypass tool may be in a closed configuration in the first tool configuration and an open configuration in the second tool configuration. The tubular housing may form part of a liner, casing, or drill string or any other tubing string for disposition in the borehole.

The tubular housing of the bypass tool may comprise at least one bypass port extending through a wall of the housing. The at least one bypass port may extend radially through the wall of the housing. The sleeve assembly may be axially movable to selectively move to the open configuration, to allow fluid communication between the housing interior wall, and an annulus defined by an outer face of the housing wall and the borehole wall.

The fluid responsive means may include a flow restriction, such that flow of fluid induces a pressure differential, and therefore a fluid pressure force, across the restriction. Alternatively, said means may define a differential piston with, for example, one piston face experiencing internal housing pressure and another face

experiencing annulus pressure, such that an increase in internal pressure will actuate the tool.

The tubular sleeve assembly may comprise a control sleeve and a flow restriction within the control sleeve for restricting the flow of fluid through the control sleeve. Preferably, the restriction is defined by an insert which may be dropped or lowered from the surface into the tubing string and may travel through the string and engage the control sleeve. Fluid flow through the flow restriction creates a force acting axially across the flow restriction, and thus on the control sleeve, urging the sleeve assembly to move axially. Alternatively, the flow restriction may be integral with the control sleeve. The flow restriction may comprise an annular, radially inwardly extending ring defining a nozzle.

The maintaining means may comprise a releasable connection, such as one or more sprung dogs, keys or a shear connection, such as one or more shear pins, for engaging the control sleeve and maintaining it in a selected one of said first and second tool configurations.

The bypass tool may further comprise a flow restriction-engaging insert, such as a nozzle, dart, sleeve or ball, for engaging the flow restriction, although as noted above in other embodiments the insert may itself provide the flow restriction. Thus, in response to pressurisation of the fluid in the tubing string above the

insert, a pressure force acting across the insert may be caused to urge the tubular sleeve assembly axially downwardly to release the connection, and in addition or alternatively to actuate the tool. The flow restriction engaging insert may be injected into the tubing string at the surface and may travel through the string bore to engage the flow restriction. When the insert is a ball, preferably the ball is deformable to allow the ball to be forced through the flow restriction in response to an increase in the pressure of the fluid in the tubing string above the ball.

In an alternative arrangement, the tubular insert may be adapted to release the connection on engaging the control sleeve.

Preferably, the downhole tool further comprises indexing means for selectively allowing actuation of the tool between said first and second tool configurations. The indexing means may comprise a cam arrangement such as a groove, slot or other profile extending around an outer circumference of the tubular sleeve assembly, and a cam follower such as a pin extending radially inwardly from an inner surface of the housing for engaging the groove. Of course, in alternative arrangements the groove or the like may be defined by the housing, and the pin or the like mounted on the sleeve assembly. In still further arrangements, the indexing means may be provided between

different parts of the sleeve assembly. The pin and groove may co-operate to rotate the tubular sleeve assembly, or at least a part of the assembly, when it is moved axially. Conveniently, the groove defines first and second axial pin rest positions. Preferably, the groove defines a plurality of first and second axial pin rest positions. The first axial pin rest position may correspond to a valve open configuration and the second axial pin rest position may correspond to a valve closed configuration. The groove may further define a plurality of third axial pin rest positions for allowing actuation of the tool to an intermediate configuration between said first and second tool configurations, and which intermediate position may provide a further tool function, or may correspond to the function provided by one of the first or second tool configurations. The third axial pin rest positions may be provided between second axial pin rest positions. Thus the groove and pin may allow the tool to be disposed in the intermediate configuration alternatively when the pressure in the borehole is increased.

The maintaining means may further or alternatively comprise a spring for applying a force upon the sleeve assembly. The spring may be a fluid spring or a compression or tension spring. Preferably, the spring is disposed in an annular cavity between the housing and the sleeve assembly, to impart an upward force upon the sleeve

assembly, to maintain it in a closed configuration.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1A is a longitudinal cross-sectional view of a downhole tool in accordance with an embodiment of the present invention;

Figure 1B is a schematic illustration of a pin and groove arrangement forming part of the downhole tool of Figure 1A;

Figure 2 is a longitudinal cross-sectional view of a downhole tool in accordance with an alternative embodiment of the present invention;

Figure 3 is a longitudinal cross-sectional view of a downhole tool in accordance with a further embodiment of the present invention;

Figure 4A is a longitudinal sectional view of a downhole tool in accordance with another embodiment of the present invention;

Figure 4B is a schematic illustration of a pin and groove arrangement forming part of the tool of Figure 4A;

Figure 5 is an enlarged view of part of the tool of Figure 4A; and

Figure 6 is a further enlarged sectional view on line 6 - 6 of Figure 5.

Referring firstly to Figure 1, there is shown a

longitudinal cross-sectional view of a downhole tool in accordance with an embodiment of the present invention, the downhole tool indicated generally by reference numeral 10. The downhole tool 10 forms part of a drill string (not shown) run into a borehole (not shown) of an oil well, and is coupled at its upper and lower ends to sequential sections of drill string tubing via threaded joints, in a fashion known in the art.

The downhole tool 10 shown in Figure 1A is a bypass tool comprising a tubular outer housing 12, a tubular bypass sleeve 14, a tubular flow restriction insert 16, a bypass sleeve spring 18 and a pin and groove assembly indicated generally by reference numeral 19.

Those of skill in the art will understand that the tool 10 will be provided with a variety of appropriate seals, however in the interest of brevity the individual seals will not be identified and described.

The tubular outer housing 12 includes flow ports 20 extending radially through a wall 22 of the housing 12, and spaced circumferentially around the housing 12. For clarity, only two such ports 20 are shown in Figure 1A, however it will be appreciated that any suitable number of such flow ports 20 may be provided in the housing 12. The housing 12 has an inner face 24 and the internal diameter of the housing 12 defined by the inner face 24 varies along the length of the housing 12 from top to bottom. In

particular, an upper portion 26 of the housing 12 is of a first general internal diameter, whilst a lower portion 28 of the housing 12 is of a smaller, second general internal diameter. This enables the housing 12, in conjunction with the tubular bypass sleeve 14, to define an annular cavity 30 in which the bypass sleeve spring 18 is located, as will be described in more detail below.

The tubular bypass sleeve 14 includes flow ports 32, and is axially movable within the housing 12, to enable the flow ports 20 of the housing 12 and the flow ports 32 of the sleeve 14 to be aligned. This allows communication between an internal tool bore 34 and an annulus defined between an outer face 36 of the housing 12 and the borehole wall.

The bypass sleeve spring 18 is a compression spring and is disposed in the cavity 30 between a washer 38 and a radially outwardly extending shoulder 40 of the bypass sleeve 14. In the position shown in Figure 1A, the bypass sleeve spring 18 maintains the bypass sleeve 14 in a closed configuration wherein an upper end 42 of the bypass sleeve 14 is disposed adjacent to the upper end of the housing 12.

When it is desired to move the bypass sleeve 14 axially downwardly against the force of the bypass sleeve spring 18, to align the flow ports 20 and 32, the tubular flow restriction insert 16 is inserted into the drill string at the surface and carried down the internal string

bore 34 until it engages the bypass sleeve 14 as shown in Figure 1A. The flow restriction insert 16 includes annular, radially inwardly extending shoulders 43 and 45, which define first and second restrictions respectively. These restrictions to the flow of fluid through the internal bore 34 are such that, when fluid flows through the flow restriction insert 16, a pressure differential is created across each restriction and a downward axial force is imparted upon the flow restriction insert 16 by the flowing fluid. Until the insert 16 is located in the sleeve 14, the tool 10 is effectively dormant, as changes in fluid flow rate or pressure in the bore 34 will have no effect on the sleeve position.

The flow rate of the fluid through the string and tool is increased until the force upon the flow restriction insert 16 becomes sufficiently large to overcome the force imparted upon the bypass sleeve 14 by the bypass sleeve spring 18. The flow restriction insert 16 and the bypass sleeve 14 then move axially downwardly, compressing the spring 18 until the bypass sleeve 14 reaches the end of its travel, wherein a lower end 44 is disposed adjacent to the lower end of the housing 12. The flow ports 20 and 32 are then aligned, allowing fluid communication between the internal bore 34 and the annulus bore. This may allow operations such as a "clean-up" operation to be carried out, wherein drill cuttings or the like lying in sections

of the borehole may be entrained with and carried back to the surface by the fluid flowing through the aligned bypass ports 32 and 20.

When it is desired to move the bypass sleeve 14 back to the closed configuration shown in Figure 1A, the flow rate of the fluid flowing through the internal bore 34 is reduced, until the fluid pressure force applied by the fluid upon the bypass sleeve 14 and the flow restriction insert 16 drops below the force imparted upon the bypass sleeve 14 by the spring 18. The bypass sleeve 14 is then moved axially upwardly by the spring 18 acting against the shoulder 40 of the bypass sleeve 14.

Referring now to Figure 1B, there is shown a schematic illustration of the pin and groove arrangement 19 shown in Figure 1A. The arrangement 19 includes an annular circumferential extending groove 46 and a pin 48, though for clarity the illustrated portion of the groove 46 is shown as a planar groove. The groove 46 is notched or corrugated and defines a number of first pin rest positions 50a and 50b, a number of second pin rest positions 52, and a number of third pin rest positions 54. The second and third pin rest positions 52 and 54 are spaced alternately around the circumference of the bypass sleeve 14. The pin 48 is shown in Figure 1B in one of the first pin rest positions 50a where the bypass sleeve 14 is in the closed configuration of Figure 1A.

When the flow restriction insert 16 has been located in the bypass sleeve 14, and the flow rate of fluid through the internal bore 34 has been increased to counteract the force of the bypass sleeve spring 18, the bypass sleeve 14 moves axially downwardly until the pin 48 engages the sloping face 56 of the groove 46, which rotates the bypass sleeve 14. The pin 48 then becomes engaged in a slot 58 and comes to rest in a second pin rest position 52, where the bypass sleeve 14 is in the open configuration with the flow ports 20 and 32 aligned. When the flow rate of the fluid is reduced, the bypass sleeve spring 18 carries the bypass sleeve 14 axially upwardly, and the pin 48 moves over the surface of a sloping face 60 of the groove 46, rotating the sleeve 14, to one of the first pin rest positions 50b.

When the flow rate is again increased, the bypass sleeve 14 again moves axially downwardly. However, movement of the sleeve 14 is stayed when the pin 48 comes to rest in the third pin rest position 54. Retention of the pin 48 in the third pin rest position 54 prevents the flow ports 20 and 32 from becoming aligned. This may be useful when, for example, it is desired to drill with drilling fluid flowing of an elevated rate but without opening the tool 10. When the fluid flow rate is next reduced, the pin 48 comes to rest in a first pin rest position 50a, whereupon subsequent increase of the fluid

flow rate allows the bypass sleeve 14 to move fully axially downwardly, with the pin 48 engaged in the second pin rest position 52. Thus alternate opening of the bypass sleeve 14 may be achieved.

Referring now to Figure 2, there is shown a longitudinal cross-sectional view of a downhole tool in accordance with an alternative embodiment of the present invention, indicated generally by reference numeral 110. For ease of reference, like components with the downhole tool 10 of Figure 1A share the same reference numerals incremented by 100. The downhole tool 110 comprises a tubular outer housing 112, a tubular bypass sleeve 114, a bypass sleeve spring 118 and a pin and groove arrangement 119. Flow ports 120 extend through a wall 122 of the housing 112, and the bypass sleeve 114 includes flow ports 132 which may be aligned with the flow ports 120 of the housing 112, when the bypass sleeve 114 is moved axially downwardly, in a similar fashion to the bypass sleeve 14 of the downhole tool 10 of Figure 1A.

The bypass sleeve spring 118 is disposed in an annular cavity 130 between a washer 138 and a shoulder 140 of the bypass sleeve 114. However, the housing 112 includes shear pins 162 disposed in the wall 122, which extend radially inwardly to engage the bypass sleeve 114. These shear pins 162 initially maintain the bypass sleeve 114 in a closed configuration as shown in Figure 2. Furthermore, the

bypass sleeve 114 includes an annular, radially inwardly extending shoulder 164 which defines a flow restriction.

When it is desired to move the bypass sleeve 114 to the open configuration, where the flow ports 120 and 132 are aligned, a deformable ball 166 is inserted into the string bore and travels down to the tool 110 through the string bore 134. The ball 166 is carried in a fluid such as drilling mud through the internal bore 134, and engages in the shoulder 164 of the bypass sleeve 114. This effectively blocks the internal bore 134. When the pressure of the fluid in the internal bore 134 above the tool 110 is increased, which may occur instantaneously on the ball 166 engaging the restriction 164, this creates a considerable pressure force acting axially downwardly upon the ball 166 and thus upon the bypass sleeve 114, which compresses the spring 118 and shears the pins 162. This moves the bypass sleeve 114 to the open configuration.

However, the internal bore 132 remains blocked by the ball 166. A further increase of the pressure of the fluid above the ball 166, or indeed a continuation of the hydraulic shock which created the initial force to shear the pins 162, causes the ball 166 to deform, elastically or plastically, and to pass through the restriction created by the shoulder 164 of the bypass sleeve 114, allowing fluid to flow through the bypass tool 110, through the flow ports 132 and 120, and into the annulus bore. A ball catcher may

be provided (not shown) disposed in the part of the drill string tubing below the tool 110, to catch the ball 166 when it has passed through the bypass sleeve 114, or alternatively the ball may disintegrate or otherwise degrade.

The pin and groove arrangement 119 includes a groove 146 and a pin 148 and functions in a similar manner to the pin and groove arrangement 19 shown in Figure 1B and described above. This therefore allows subsequent opening and closing of the bypass sleeve 114 in response to variations in the fluid flow rate acting on the flow restriction 164.

Referring now to Figure 3, there is shown a downhole tool in accordance with a further embodiment of the present invention, indicated generally by reference numeral 210. For clarity, like components of the tool 210 with the tool 10 of Figure 1A share the same reference numerals incremented by 200.

The downhole tool 210 comprises a tubular outer housing 212, a tubular bypass sleeve 214, a bypass sleeve spring 218, a pin and groove arrangement 219 and a tubular release sleeve 268. The housing 212 includes flow ports 220 disposed in a wall 222 of the housing 212 and extending radially therethrough.

The tubular bypass sleeve 214 includes flow ports 232 and is mounted in the housing 212 to define an annular

cavity 230, in which the spring 218 is disposed, between a washer 238 and a shoulder 240 of the housing 212. Elastomeric O-ring type seals 270 and 272 respectively are provided in the wall 222 of the housing 212, to seal the annular cavity 230 and isolate it from fluid in the internal tool bore 234. Also, bleed holes 274 extend through the wall 222 of the housing 212, to fluidly couple the annular cavity 230 with the annulus of the borehole in which the tool 210 is disposed. Thus fluid in the annular cavity 230 experiences the same pressure as fluid in the annulus.

The bypass sleeve 214 includes openings 276 at its upper end 242, for engaging spring-loaded locking dogs 278, to retain the sleeve 214 in the closed configuration shown in Figure 3, whereby the flow ports 220 and 232 are misaligned. This prevents fluid communication between the internal bore 234 and the annulus bore. As shown in Figure 3, the leading end 280 of each locking dog 278 is chamfered. This allows the release sleeve 268 to be run into the borehole and located within the bypass sleeve 214 as shown in Figure 3, wherein a radially outwardly extending shoulder 282 of the sleeve 268 engages the leading end 280 of each locking dog 278. This compresses a spring 284 of each locking dog 278, forcing each locking dog 278 radially outwardly such that only the chamfered leading end 280 protrudes into the apertures 276.

To actuate the tool 210 to an open configuration, the pressure of fluid flowing through the internal bore 234 is increased such that the differential pressure between the fluid in the internal bore 234 and the fluid in the annulus bore increases. As the seal 270 defines a larger diameter than the seal 272, a net axially downward force is imparted upon the bypass sleeve 214 due to this differential pressure. This causes the actuating sleeve 268 and the bypass sleeve 214 to move axially downwardly. The locking dogs 278 are disengaged from the engaging apertures 276 of the bypass sleeve 214 by the bypass sleeve 214 passing over the chamfered leading end 280 of each locking dog 278. This allows the flow ports 220 and 232 to be aligned, allowing fluid communication between the internal tool bore 234 and the annulus. When the pressure of the fluid in the internal bore 234 is reduced sufficiently such that the net force upon the bypass sleeve 214 falls below the restoring force of the spring 218, the spring 218 returns the bypass sleeve 214 to the closed configuration shown in Figure 3, by acting against the shoulder 240 of the housing 212.

The pin and groove arrangement 219 comprises a groove 246 and a pin 248 similar to the groove 46 and pin 48 of Figure 1B and the tool 10 of Figure 1A. When the bypass sleeve 214 returns to the closed configuration of Fig 3, the locking dogs 278 again engage the engaging holes 276 of the bypass sleeve 214 to retain the sleeve in the closed

configuration, until the pressure of the fluid in the internal bore 234 is increased sufficiently to counteract the spring force 218 and force the locking dogs 278 radially outwardly.

Reference is now made to Figure 4A of the drawings, which illustrates a bypass tool 310 in accordance with another embodiment of the invention. The tool 310 is similar in some respects to the tool 210 of Figure 3, and therefore common features of the tools 210, 310 will not be described again in any detail.

The tool 310 comprises a housing 312, a two-part bypass sleeve 314, a flow restriction sleeve 316, a pair of sleeve springs 318a, 318b, and a sleeve movement controlling pin and groove assembly 319.

Unlike the previous illustrated tools, the tool 310 is illustrated in a configuration in which the tool 310 is experiencing elevated fluid flow therethrough, but the sleeve movement controlling assembly 319 has not transmitted the corresponding axial movement of the restriction sleeve 316 and the associated part of the bypass sleeve 314a to the other part of the sleeve 314b defining the flow ports 312, as will be described below.

The tool 310 is initially run in without the restriction sleeve 316. As noted above, the bypass sleeve 314 is in two parts 314a, 314b, coupled by the pin and groove arrangement 319, the form of which is illustrated in

Figure 4B of the drawings. The upper sleeve part 314a, which defines the groove 346, is initially locked to the housing 312 by an arrangement of sprung dogs 378, as illustrated in Figure 6 of the drawings. The dogs 378 are mounted in the sleeve 314a and are biassed radially outwardly to engage recesses 376 in a sleeve 386 located on the housing 312 between a circlip 388 and a housing shoulder 390. Four circumferentially spaced dogs are provided, and are adapted to be retracted by the radial movements of respective release pins 392 coupled to the dogs 378 by rocker arms 394. In this position, the springs 318a, 318b which act on the respective sleeve parts 314a, 314b, to urge the sleeve parts towards the closed position, are fully extended.

In this initial configuration, the tool 310 is effectively dormant, and variations in fluid flow or pressure differentials will have no effect on the tool configuration. This allows the tool 310 to be effectively "ignored", until the tool 310 is required. This is useful as it allows, for example, drilling operators to vary drilling mud flowrate and pressure, and to switch mud pumps on and off without any concern for the tool configuration.

When it is desired to utilise the tool 310, the sleeve 316 is placed in the drill string, and will be carried to the tool 310 in the drilling fluid. The presence of restrictions 343, 345 in the sleeve 316 facilitates the

sleeve 316 being carried by the flow, however the relatively minor flow restriction created by the free-falling sleeve 316 allows the drilling operators to maintain drilling fluid flow at the normal drilling rate, such that drilling is not interrupted by the passage of the sleeve 316 through the string to the tool 310.

On reaching the tool location, the sleeve 316 engages the upper part of the bypass sleeve 314a, and in doing so pushes the release pins 392 outwardly to disengage the sleeve 314a from the housing 312. The engagement of the restriction sleeve 316 with the bypass sleeve 314a creates a restriction in the fluid pathway through the string, but not to the extent that a significant hydraulic shock is induced.

Flow through the restrictions 343, 345 creates a differential pressure force across the sleeve 316 and, if the force is sufficient, the upper by-pass sleeve 314a will move downwards, compressing the spring 318a. Further, depending on the position of the pin 348 in the groove 346, the pressure force will be transferred to the lower bypass sleeve 314b. If sufficient force is created, the sleeve 314b may be moved downwards, compressing the spring 318b, and aligning the ports 332,320.

By varying the drilling fluid flow rate through the tool 310, it is thus possible to cycle the position of the sleeve parts 314a, 314b, to selectively open or close the

ports 332, 320.

If there comes a point in the drilling operation where the tool 310 is no longer required, the sleeve 316 may be retrieved by wireline or the like and using a fishing tool adapted to engage a profile 390 in the upper end of the sleeve 316.

Various modifications may be made to the foregoing embodiments within the scope of the present invention. For example, the downhole tool may be any tool capable of being actuated between first and second tool configurations.

CLAIMS

1. A fluid flow actuated downhole tool being configurable in at least a first tool configuration and a second tool configuration, the tool comprising:

a tubular housing;

an activating sleeve, the housing being adapted to catch the sleeve when the sleeve is dropped from surface and the caught sleeve permitting actuation of the tool between the first and second tool configurations; and

flow restriction means for permitting fluid flow actuation of the tool when the activating sleeve has been caught in the body.

2. The tool of claim 1, wherein the sleeve defines a flow restriction.

3. The tool of claim 2, wherein at least two axially spaced flow restrictions are provided in the sleeve.

4. The tool of claim 1, 2 or 3, wherein the tool is a bypass tool.

5. The tool of claim 4, wherein the bypass tool is

normally closed.

6. The tool of any of the preceding claim, wherein the sleeve is adapted to be retrievable from the housing.

7. A method of operating a fluid flow-actuated tool, the method comprising:

running the tool into a borehole in a tubular string;

circulating fluid through the string and the tool;

dropping an activating sleeve into the string;

catching the sleeve in the tool; and

circulating fluid through the string, the sleeve and a flow restriction in the tool to actuate the tool.

8. The method of claim 7, wherein fluid is circulated through the string at a rate sufficient to provide cuttings entrainment while the sleeve passes through the string.

9. The method of claim 7 or 8, wherein following actuation of the tool, the tool is repeatedly actuated between first and second tool configurations.

10. The method of any of claims 7 to 9, wherein the tool is a bypass tool and is actuated between a closed and an open position.

11. The method of any of claims 7 to 10, further comprising the step of retrieving the sleeve from the tool.

12. A method of operating a fluid flow actuated tool, the method comprising:

(a) running the tool into a borehole in or as a part of a tubular string;

(b) circulating fluid through the string and tool;

(c) passing an activating device into the tool;

(d) catching the device in the tool;

(e) circulating fluid through the string and the tool including the device, to actuate the tool; and

(f) repeating step (e) at least once.

13. The method of claim 12, wherein the activating device is a sleeve.

14. The method of claim 13, wherein the activating device is a sleeve defining a restriction.

15. The method of claim 12, 13 or 14, wherein activation of the tool is achieved by releasing a coupling to permit relative movement of parts of the tool.

16. The method of claim 15, wherein the coupling is a shear coupling.

17. The method of claim 15, wherein the coupling is a sprung coupling.

18. The method of claim of any of claims 12 to 17, wherein the tool is a bypass tool and is actuated between a closed and an open position.

19. A method of actuating a downhole tool, the method comprising:

running a tool into a borehole in a tubular string;

circulating fluid through the string and tool;

locating an activating device in the string; and

circulating fluid through the string and tool as the device travels down through the string, as the device engages the tool, and following engagement of the device and the tool.

20. The method claim 19, wherein the method further comprises drilling as the device travels through the string.

21. The method of claim 19 or 20 wherein the fluid circulating rate is maintained at a level sufficient to maintain cutting entrainment.

22. The method of claim 19, 20 or 21, wherein the

activating device is a sleeve.

23. The method of claim of any of claims 19 to 22, wherein the tool is a bypass tool and is actuated between a closed and an open position subsequent to location of the activating device in the tool.

24. A downhole tool for disposition in a borehole of a well, the tool being configurable in at least a first and a second tool configuration, the tool comprising:

a tubular housing for running into a borehole on a tubing string;

a tubular sleeve assembly for disposition within the tubular housing and axially movable therein and including fluid responsive means for actuating the tool between said first and second tool configurations, the fluid responsive means including a restriction;

a restriction-engaging insert for engaging the restriction; and

means for maintaining said sleeve assembly in a selected one of said first and second tool configurations.

25. The tool of claim 24, wherein the tool is a bypass tool and is in a closed configuration in the first tool configuration and an open configuration in the second tool configuration.

26. The tool of claim 25, wherein the sleeve assembly is selectively movable to the open configuration.

27. The tool of any of claims 24 to 26, wherein the tubular sleeve assembly comprises a control sleeve and a flow restriction within the control sleeve for restricting the flow of fluid through the control sleeve.

28. The tool of claim 27, wherein the restriction is defined by an insert which is dropped from the surface into the tubing string and travels through the string and engages the control sleeve.

29. The tool of any of claims 23 to 28, wherein the maintaining means comprises a releasable connection for engaging the control sleeve and maintaining it in a selected one of said first and second tool configurations.

30. The tool of claim 29, further comprising a tubular insert adapted to release the connection on engaging the control sleeve.

31. The tool of claim 24, 25 or 26, wherein the fluid responsive means defines a differential piston.

32. The tool of any of claims 24 to 31, wherein the insert is a ball.

33. The tool of any of claims 24 to 31, wherein the insert is a sleeve.

34. The tool of any of claims 24 to 33, wherein the downhole tool further comprises indexing means for selectively allowing actuation of the tool between said first and second tool configurations.

35. The tool of claim 34, wherein the indexing means comprises a cam arrangement.

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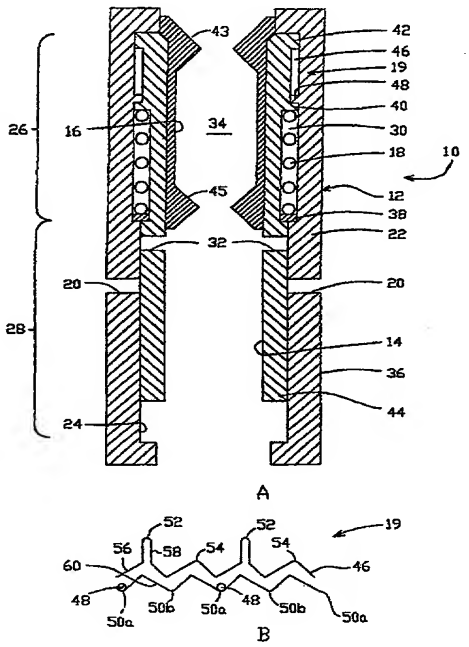

(57) Abstract: A fluid flow actuated downhole tool is configurable in at least a first tool configuration and a second tool configuration. The tool comprises a tubular housing and an activating sleeve, the housing being adapted to catch the sleeve when the sleeve is dropped from surface and the engagement of the sleeve with the housing permitting actuation of the tool between the first and second tool configurations. A flow restriction is provided for permitting fluid flow actuation of the tool when the activating sleeve has been caught in the body.

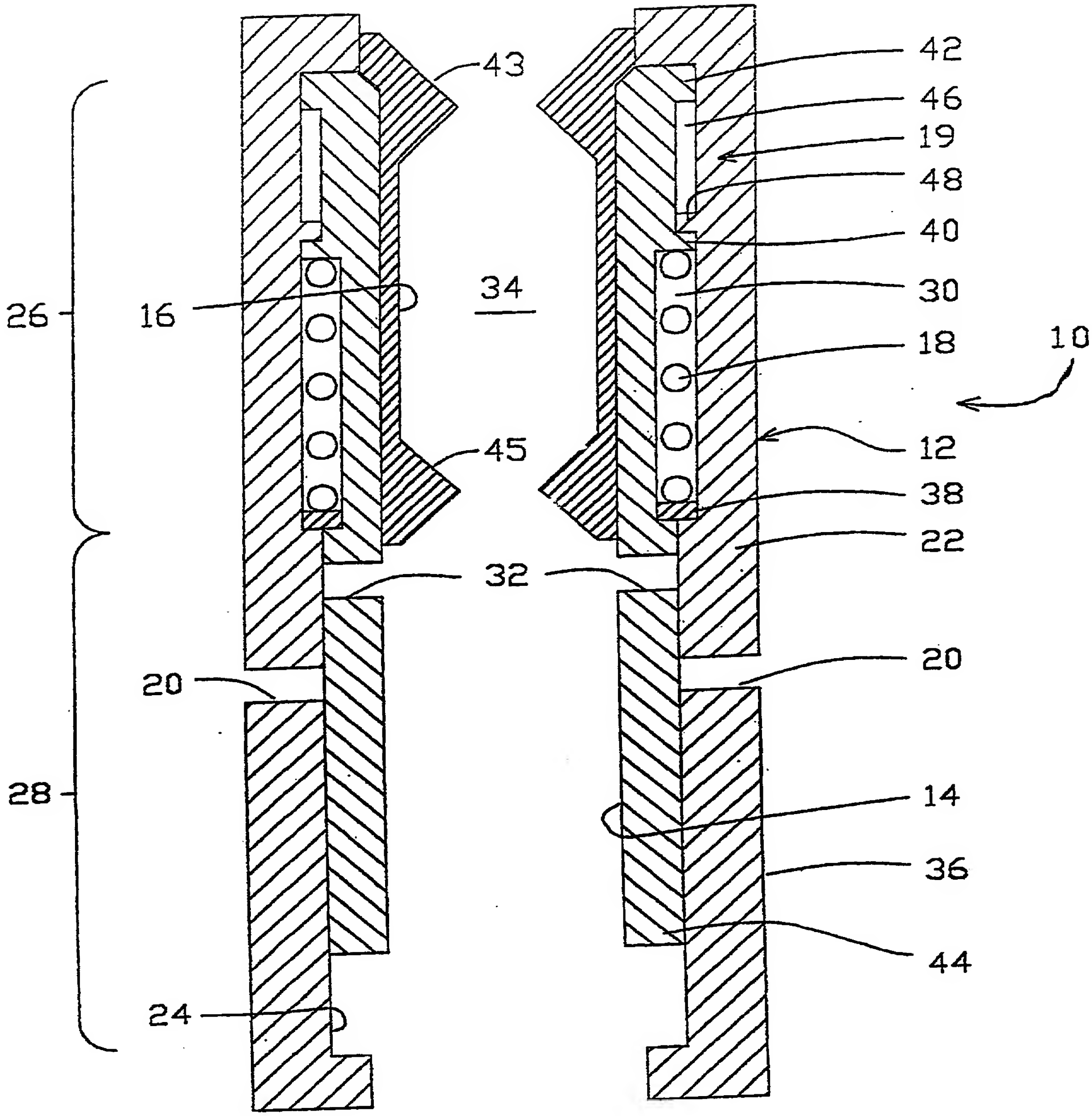

Figure 1A

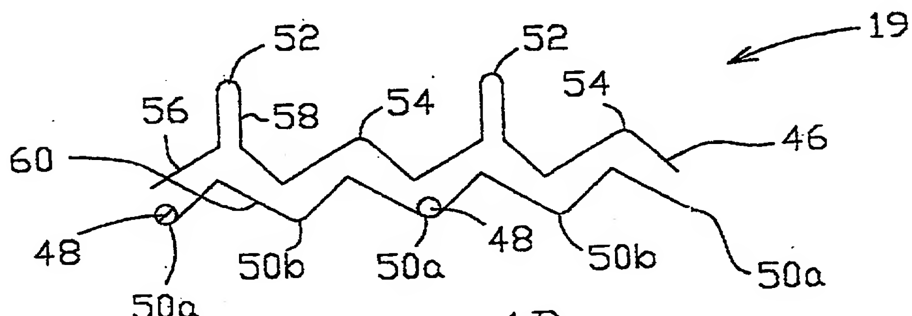

Figure 1B

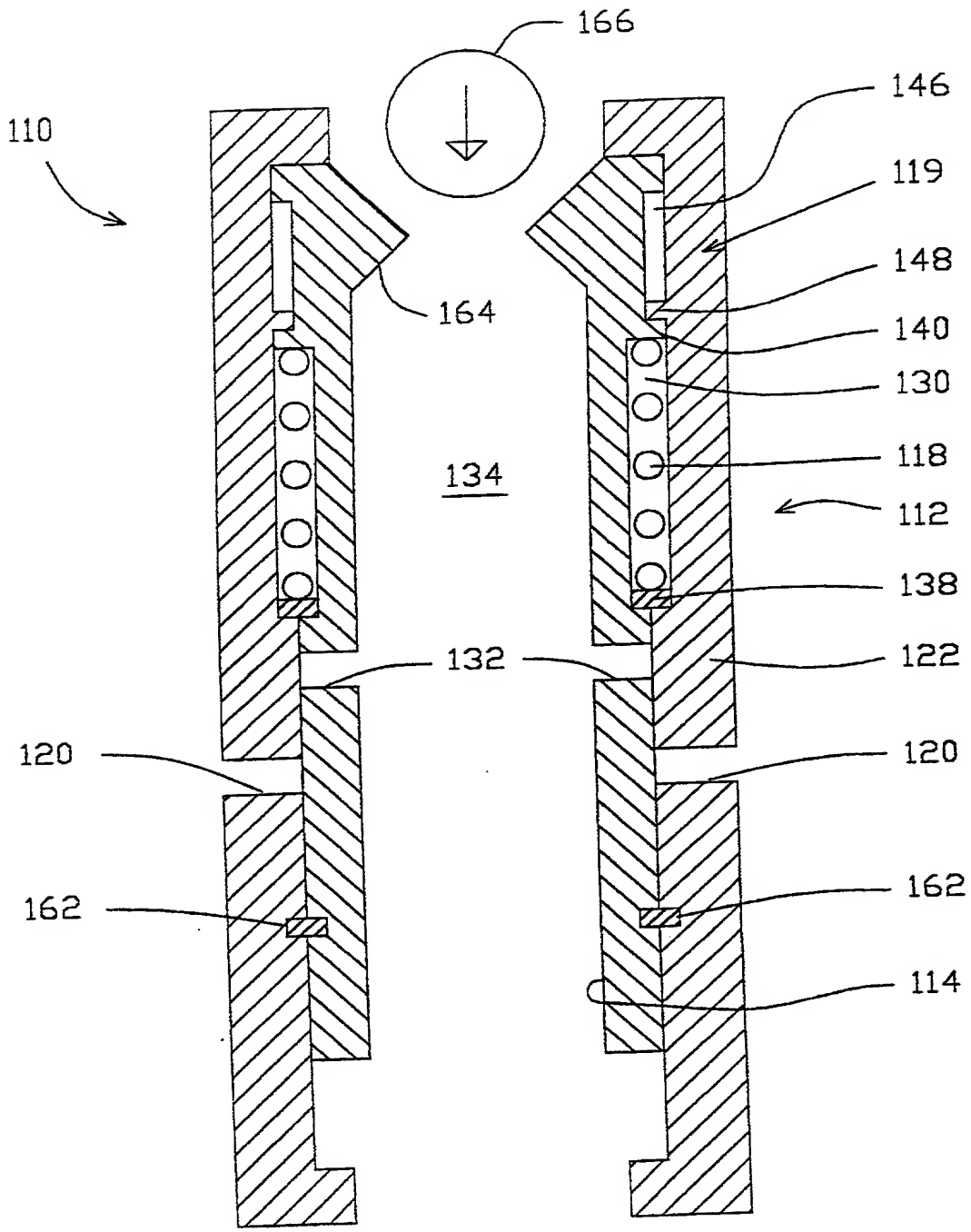
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Figure 2

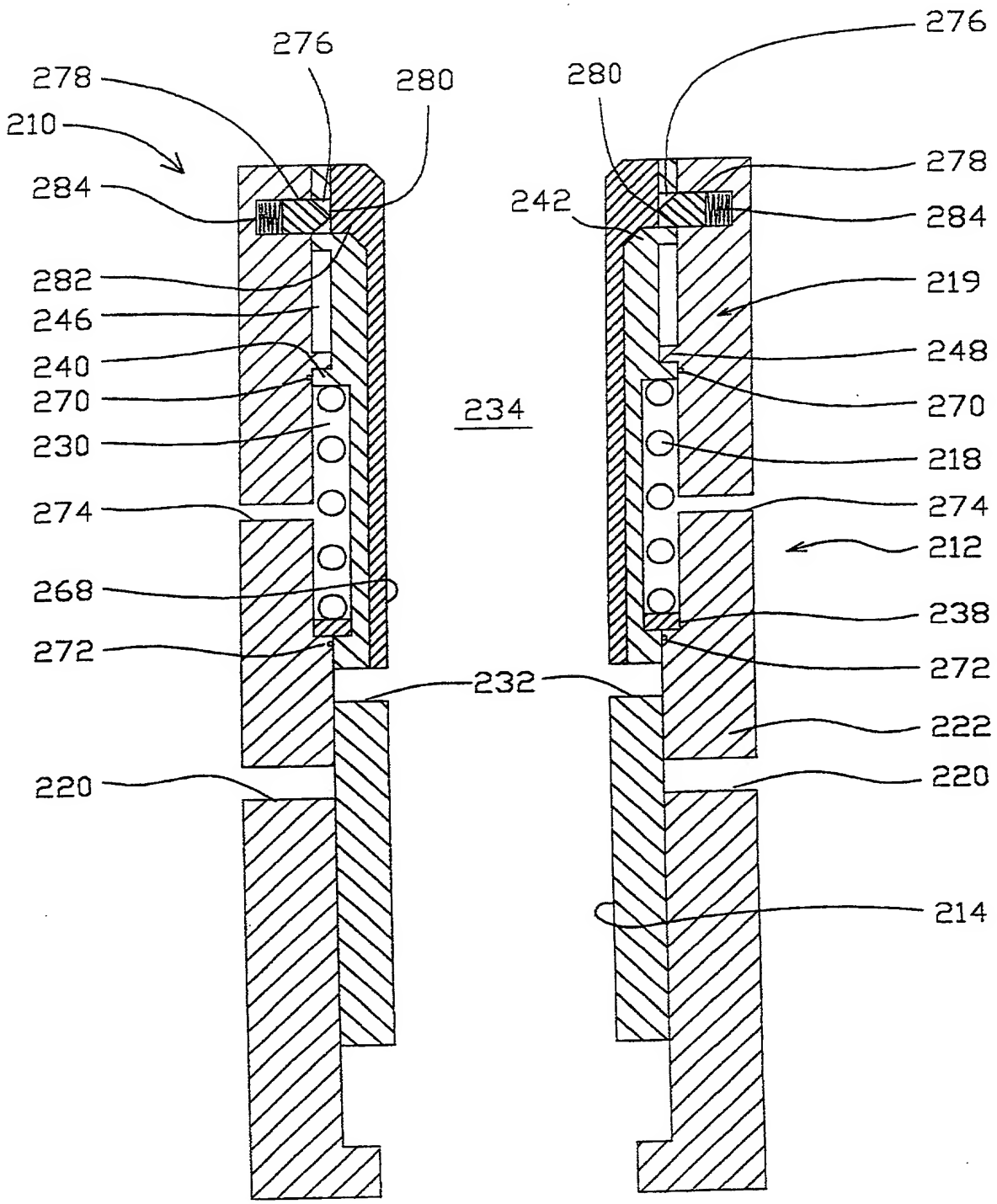
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Figure 3

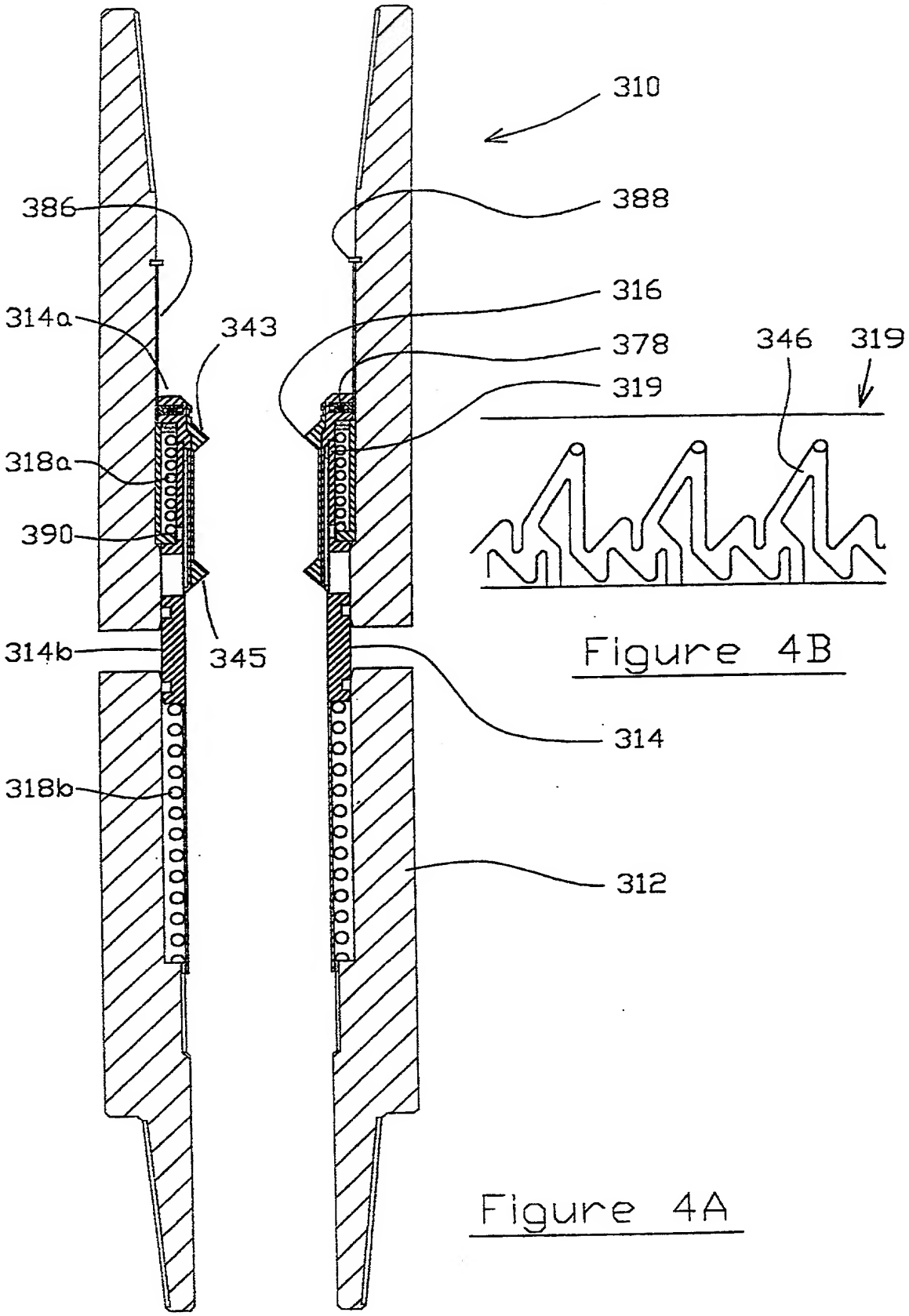

Figure 4B

Figure 4A

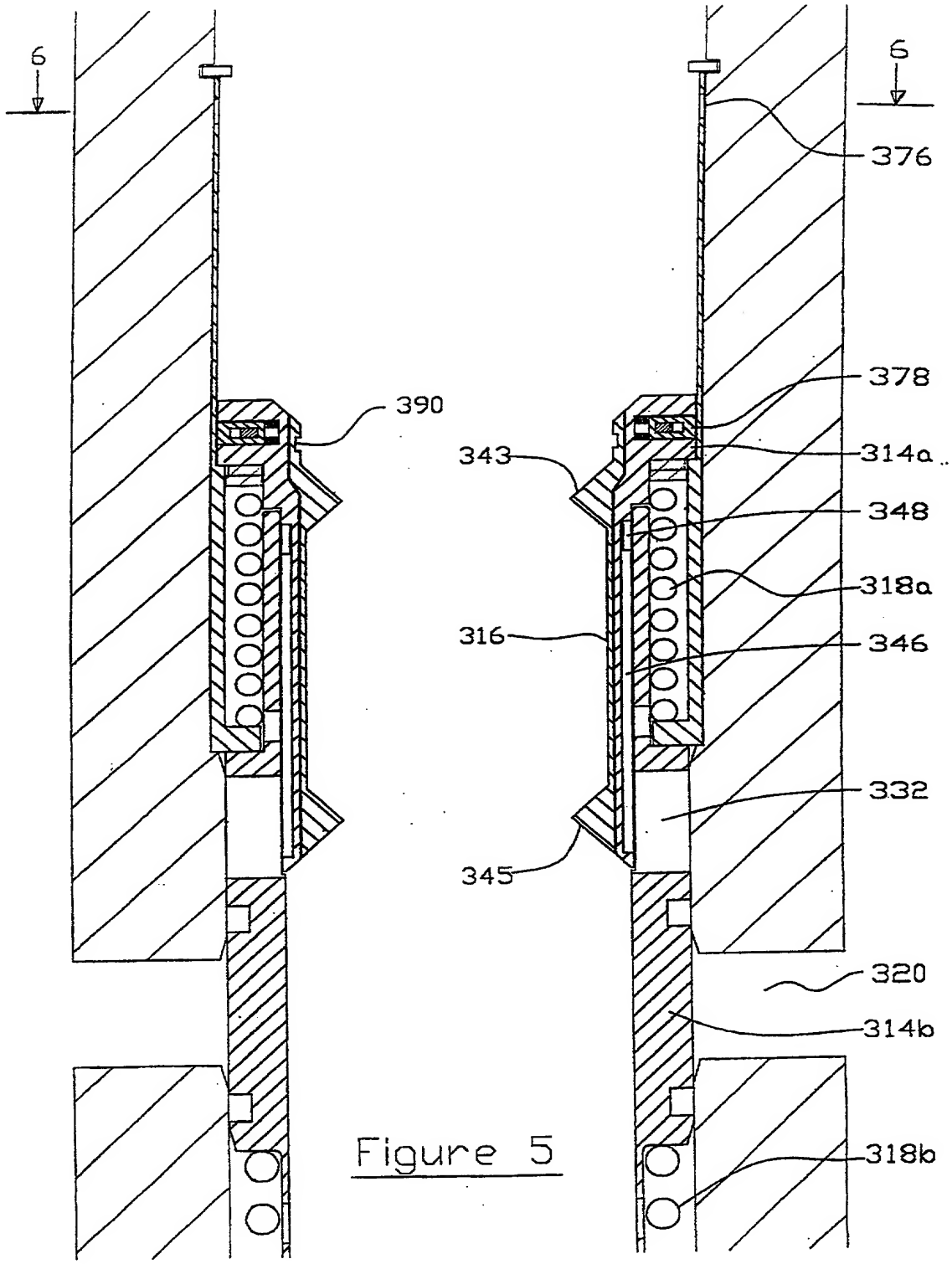

Figure 5

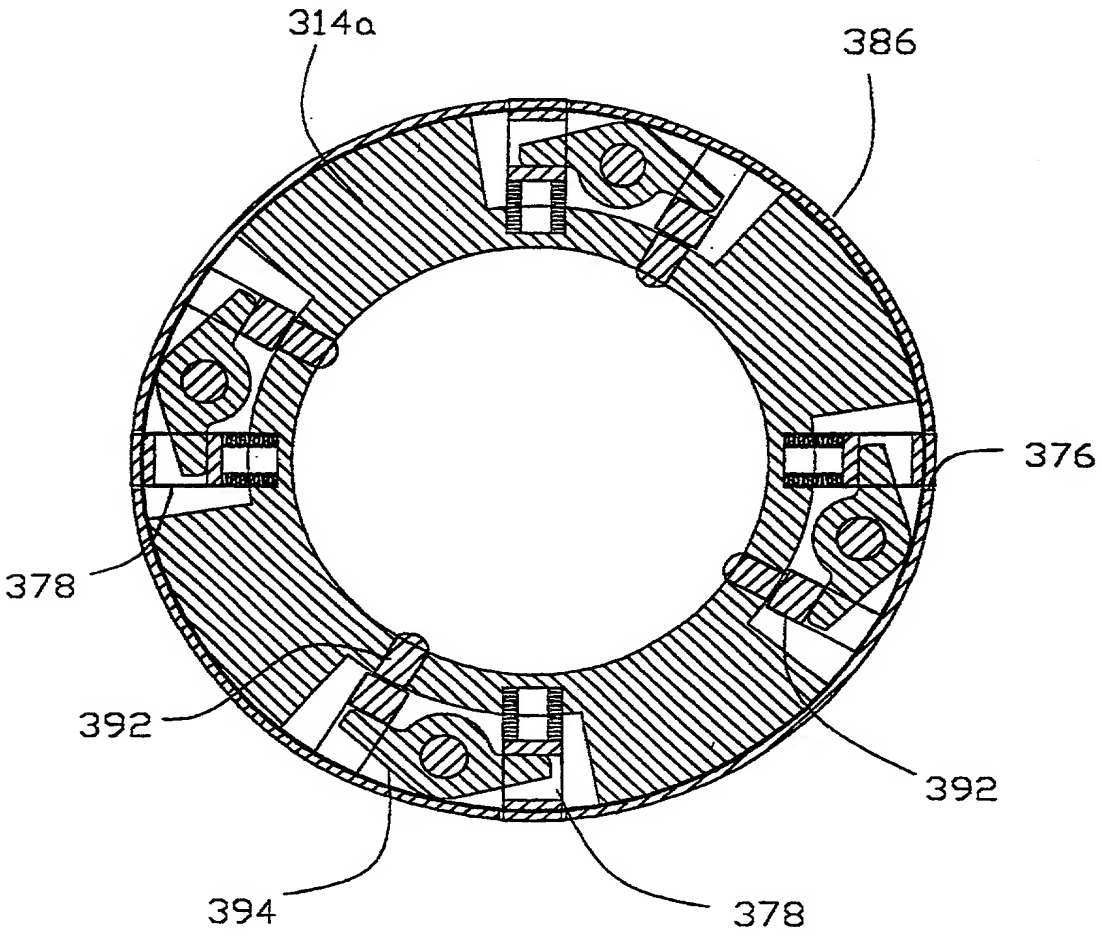

Figure 6

ATTORNEY DOCKET NO. **CAF-29302/03**

DECLARATION, POWER OF ATTORNEY AND PETITION

As the below named inventor, I hereby declare:

my residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **DOWNHOLE TOOL**, the specification of which

[ ] is attached hereto.
[X] was filed on **14 July 2000**,
as Application Serial No. **PCT/GB00/02712**
and was amended on _____ (if applicable).
[ ] was described and claimed in PCT International Application No. _____
and as amended under PCT Article 19 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent & Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

PRIORITY CLAIM UNDER 35 USC § 119(a)-(d)

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign applications(s) for patent or inventor's certificate, or §365(a) of any PCT International Applications designating at least one country other than the U.S. listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT International Applications designating at least one country other than the U.S. having a filing date before that of the application on which priority is claimed:

[ ] no such applications have been filed
[x] application(s) listed below:

PRIOR FOREIGN APPLICATIONS(S)
Filed Within Twelve Months (Six Months For Design) Of This Application

			PRIORITY CLAIMED YES	NO
9916513.6	United Kingdom	15 July 1999	[x]	[ ]
(Number)	(Country)	(Day/month/year filed)		
			[ ]	[ ]
(Number)	(Country)	(Day/month/year filed)		
			[ ]	[ ]
(Number)	(Country)	(Day/month/year filed)		

CLAIM FOR BENEFIT OF PROVISIONAL APPLICATION UNDER 35 USC §119(e)

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States Provisional application listed below:

PROVISIONAL APPLICATION NO.	FILING DATE

CLAIM FOR BENEFIT OF EARLIER APPLICATIONS UNDER 35 USC §120

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT International Application(s) designating the U.S. listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the U.S. Patent & Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

PCT/GB00/02712	14 July 2000	Pending
(App. Serial No.)	(Filing date)	(Status) (patented, pending, abandoned)
(App. Serial No.)	(Filing date)	(Status) (patented, pending, abandoned)

PRIOR FOREIGN APPLICATIONS
(Filed More Than Twelve Months (Six Months for Design) Prior To This Application

(Number)	(Country)	(Day/month/year filed)
(Number)	(Country)	(Day/month/year filed)
(Number)	(Country)	(Day/month/year filed)

POWER OF ATTORNEY

And I hereby appoint Ernest I. Gifford, P.O. Reg. 20,644; Allen M. Krass, P.O. Reg. No. 18,277; Irvin L. Groh, P.O. Reg. No. 17,505; Douglas W. Sprinkle, P.O. Reg. No. 27,394; Thomas E. Anderson, P.O. Reg. No. 31,318; Ronald W. Citkowski, P.O. Reg. No. 31,005; Judith M. Riley, P.O. Reg. No. 31,561; Douglas J. McEvoy, P.O. Reg. No. 34,385; Ellen S. Cogen, P.O. Reg. No. 38,109; Roberta J. Morris, P.O. Reg. No. 33,196; John G. Posa, P.O. Reg. No. 37,424; Douglas L. Wathen, P.O. Reg. No. 41,369; Avery N. Goldstein, P.O. Reg. No. 39,204; Mark D. Schneider, P.O. Reg. No. 43,906; and Beverly M. Bunting, P.O. Reg. No. 36,072, as my attorneys, to prosecute this application and to transact all business in the United States Patent and Trademark Office connected therewith. Send all correspondence to: **Judith M. Riley**, 280 N. Old Woodward Avenue, Suite 400, Birmingham, Michigan 48009; Telephone (248) 647-6000.

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Date Citizenship

Residence

Post Office Address

Full name of third, joint inventor, if any

Inventor's signature

Date Citizenship

Residence

Post Office Address

Attorney Docket No. CAF-29302/03

PATENT

DECLARATION AND POWER OF ATTORNEY FOR
PATENT APPLICATION
ENGLISH LANGUAGE DECLARATION

As a named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled DOWNHOLE TOOL

the specification of which:

(check one)

( ) is attached hereto.

(X) was filed on 14 JULY 2000 as PCT\GB00\02713

application Serial No.

was amended on

(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application on which priority is claimed:

Prior foreign Application(s)			Priority Claimed	
9916013.8	UNITED KINGDOM	15 JULY 1999		X
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

Application Serial No.	Filing Date	Status (patented, pending, abandoned)
Application Serial No.	Filing Date	Status (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number):

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